HONS 158L Syllabus

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Office Hours: T–F 1:30-3:00, or by appointment.

Required Materials: Physics text, calculator, lab notebook

WebCT: This class has a WebCT page at http://webct.cofc.edu. All students will be automatically enrolled. The lab schedule and your grades will be available from this page.

Lab will meet Mondays from 1:00 to 3:50 in room 106 of the Science Center. You are expected to attend all labs and to participate fully in the taking and analysis of data. Each student must keep a lab notebook in which all information about a lab is recorded. This notebook must be dedicated solely to physics lab since it will be turned in three times during the semester to be graded. The notebook should be complete; i.e., someone who is taking physics should be able to reconstruct the experiment, do the calculations and arrive at conclusions based on what is in your notebook.

Some labs will begin with a short quiz based on the lab for the day.

Three times during the semester the notebooks will be collected and graded. When the notebooks are returned each person in your lab group will be assigned to write a formal lab report on one of the completed labs. The notebooks are collected at the end of lab Monday, are graded and ready to be picked up on Wednesday, and the formal report is due at the beginning of lab the following Monday. Collection dates: **Feb. 11, March 17, March 31.**

Your grade in lab is determined by:

Average of lab quizzes	25 %
Lab Project	25 %
Lab notebook	25 %
Formal lab reports	25 %

Lab Project: During the semester you will be required to design and carry out an experiment of some aspect of physics from this semester's topics. You will turn in a written report (similar to the formal lab reports described below) and give a 5 minute presentation on your project.

Formal Lab Reports: You must complete three formal lab reports during the semester. The reports are due **Feb. 18, March 24, and April 7.**

Schedule of Labs:

1/14	Electrostatics
1/28	Simple Circuits
2/4	Kirchhoff's Laws
2/11	Magnetism
2/18	Faraday's Law
2/25	*RC* Circuits
3/10	Reflection-Refraction
3/17	Thin Lenses
3/24	Diffraction
3/31	Spectroscopy
4/7	Independent Projects
4/14	Oral Presentations

Introduction

Physics is a science of observation and measurement of the properties of the physical world. The primary purpose of this laboratory is to provide firsthand experience in making observations and recording and analyzing data in order to gain an understanding of basic physical concepts and theories. To accomplish this purpose it will be necessary for you to gain familiarity with a variety of instruments used to make measurements and to analyze these measurements. Computers may play a significant part in the collection and analysis of the data.

Operation of the Laboratory

The laboratory will meet at 1:00 on Mondays in room 106. Prior to lab time you are expected to have studied the material in the weekly lab handout. Most labs will begin with a quiz. Following the quiz a short explanation of the current week's lab will be presented. The actual execution of the experiment will normally be done in groups of two or three. Each person is expected to participate fully in all aspects of the experiment and to keep their own lab notebook.

Laboratory Notebook and Good Laboratory Practice

The book in which the initial measurements are taken and in which the results are calculated and a conclusion made is called the lab notebook. The data in the lab notebook must be recorded in a permanent form and with enough explanation so that memory is not required to figure out what a set of numbers is about. The lab notebook should be written so that someone years in the future can tell what you did and what the results were. It only requires a few sentences and a few words of explanation to make the lab notebook intelligible to such a person. Try to keep this person in mind as you are recording data in your lab notebook.

It is also important to remember to write everything down in the lab notebook as it happens. Don't write information on scraps of paper to later "copy" into the lab notebook. This practice defeats one of the main purposes in keeping a lab notebook.

There are several important points to remember about working in the laboratory and keeping a lab notebook. The following are taken from Walter Pauk's *How to Study in College*.

- Do not trust memory. Write down everything you think may be pertinent. Some things observed in the laboratory may strike you as being so clear at the time that there seems to be no point in writing them down. But memory fades and if the experiment is not completely written up in the same period in which it is performed, you may not be able to recall important items. These may include identification and properties of the instruments, ranges and units of the scales in the meters, dimensions and schematic diagrams of apparatus, sensitivity of a balance, headings and units for columns of data, quirks of performance of equipment, need for repetition of measurements, and numerous other details.

- Make a permanent record of observations. Follow the practice of professional scientists in keeping a full record of your calculations, observations, and results in your laboratory notebook — don't ever write anything down on separate scraps of paper — not even your arithmetical calculations. If you make a mistake, cross them out lightly and go on from there, but keep everything as part of your complete record. Start your record of each new experiment or laboratory session on a new page headed with the date. In this way you will have a permanent log of all your data and mental processes pertaining to any problems on which you have worked — all the materials for your final report.

- Organize the recording of data. Arrange them so that they will be clear and fully labeled for future reference. The few extra minutes you take to make neat and orderly records during the laboratory period will save you time that you would otherwise have to spend later in deciphering and arranging haphazard notes.

- Do not trust yourself or the apparatus too much. It is an unwise practice to record a lot of untested numbers, dismantle the apparatus and leave the laboratory, intending to analyze that data and deduce the result of the experiment at a later time. It is much better to carry out at least an approximate analysis (including rough graphs) of the data while they are being taken, so that you have a chance to detect anything that is going wrong in time to do something to remedy the situation — such as readjusting the apparatus, checking or repeating an observation or asking an instructor for advice or assistance.

- Baby the apparatus. Another skill, often invisible to those who do not possess it, is the ability to manipulate delicate apparatus and distinguish small variations in its behavior. It is sometimes amazing what consistently accurate measurements can be coaxed out of laboratory apparatus by unusually sensitive hands and eyes, or what can be seen in a microscope or telescope by some students and not by others. People are not born with such skills, rather they develop them by conscientious, loving effort.

  Poor performance in a laboratory is often due to carelessness, but may also be the result of a pessimistic or uncooperative attitude: being too ready to say an apparatus doesn't work, or to accept unnecessary limitations on its capability. The trick is to regard the apparatus as your friend, not your opponent; the rest follows naturally with practice. So treat it tenderly, and coax out of it all the resolution and accuracy of which it is capable. Make notes of its limitations and the expected accuracy of the measurements. And watch the apparatus like a hawk for signs of strange behavior. No real equipment is quite like the ideal version pictured in a textbook or laboratory manual. Typically, each piece of apparatus has an individual personality.

- Keep purpose in mind. Try to know the purpose of the particular laboratory work in which you are engaged, which varies a great deal from case to case, and keep it in mind. Doing so can save much expenditure of useless effort and prevent overlooking the main point of the exercise.

Formal Laboratory Reports

Three times during the semester you will be required to write a formal laboratory report. In your report you should try to explain what you were trying do to, how you did it, and what the results and conclusions were. At a minimum, your report must contain:

1. An abstract — A short summary of your objective, results, and conclusions. This should normally be no more than a paragraph.

2. Theory — This section contains any derivations which you carried out and a summary of the theoretical expectations of your experiment. You must include at least one outside reference. *The Physics Teacher*, *American Journal of Physics*, and *Scientific American* are good sources.

   *** The Wikipedia is not a suitable reference due to trust issues and the usually low-level of general physics articles, which often list general physics textbooks as their sources.

3. Procedure — Include the equipment used and the actual steps you took in "doing" the experiment.

4. Data — A record of all measurements you made in a neat and orderly fashion.

5. Calculations and Results — Show at least an example of each type of calculation needed. The end result of your experiment is put in this section.

6. Conclusions — Examine your results and summarize any conclusion you can draw (what you tried to prove is true, untrue, inconclusive). Any error analysis is put in this section.

A "multi-part" lab may repeat sections 3–6 several times, with a final concluding section for the entire lab.

All reports must be typed.

Mathematical formulae may be neatly written by hand (in ink) unless you have a very good scientific word processor, i.e., LaTeX.

$$-\frac{\hbar^2}{2m}\nabla^2\psi + V(\vec{r})\psi = E\psi$$